TEXAS AGRICULTURAL EXPERIMENT STATION

A. B. CONNER, DIRECTOR
College Station, Texas

BULLETIN NO. 623 NOVEMBER 1942

CONTROL OF EGGPLANT YELLOWS

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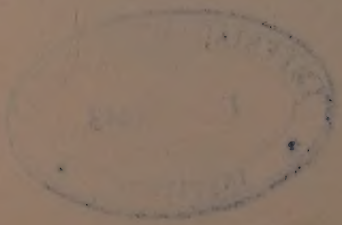
12-6M-L180



Eggplants grown during the late summer and fall months in South and Central Texas are usually affected with a disease commonly called "eggplant yellows," which may cause most of the plants in a field to turn yellow and fail to bear a full crop. Conspicuous yellow spots first appear on the young leaves in the terminal buds. These areas increase in size, frequently following the veins, and gradually destroy the green color in the plant. The contrast of yellow and green in an eggplant field is apparent at a considerable distance. The disease is infectious and appears to be caused by a virus, but the method of natural transmission is not yet known.

The most practical control of eggplant yellows was obtained by keeping the plants lightly covered with sulfur dust throughout the time they were in the seedbed. This treatment plus two or more dust applications after the plants were set in the field gave even better control of the disease, but the additional applications were not found profitable. Satisfactory control of eggplant yellows was not obtained when dusting was begun after the disease appeared in the field.

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Eggplant growers throughout south and central Texas are familiar with a disease which causes the plants to turn yellow and fail to fruit normally. Scattered plants may develop the conspicuous yellow color soon after transplanting and by the end of the season most of them may be diseased. Soil and cultural conditions seem to have little or no relationship to the prevalence of the disease, except that stunted plants are usually less likely to become infected than rapidly growing plants. Eggplants grown on new ground or isolated many miles from other plantings may be just as severely damaged as where the crop is grown continuously on one farm. Scattered plants here and there turn yellow while adjoining plants may remain healthy throughout the season. The disease is usually more prevalent in the fall than in the spring or early summer.

REVIEW OF LITERATURE

The first mention of eggplant yellows in scientific literature was made by Taubenhaus and Hawthorn (11) in 1933. They gave a brief description of the disease and stated that it was very common in South Texas and to a less extent wherever eggplants are grown in the state. Hawthorn and Taubenhaus (1) reported the following: "A series of treatments involving soil amendments such as sulphur, iron sulphate, and superphosphate in various amounts and combinations, failed to correct the condition or prevent its spread. Likewise dusting with sulphur, as well as spraying with iron sulphate in various dilutions, failed to produce any response." The disease was transmitted in 3 out of 7 trials when infected buds were grafted on healthy plants by Taubenhaus and Hawthorn (12) who reported: "From the evidence on hand, it appears that eggplant 'yellows' is probably of a virus nature, and for this reason was unaffected by the sulphur or iron sulphate treatments". In later tests Taubenhaus (10) reported that 6 out of 10 grafted plants became infected. Ivanoff (2) in recent studies obtained additional information on the nature of the disease, which is discussed in this publication.

Jones and Janes (7) first reported that remarkable and satisfactory control of eggplant yellows was obtained by dusting the plants with a rotenone-sulfur mixture, beginning while the plants were in the seedling stage and before infection took place. Growing the seedlings under screen cages to protect them from insects was of some benefit. They

*Appointed Superintendent of Substation 17, Ysleta, January 1, 1942. M. J. Janes was in charge of these investigations in 1936 and 1937 during the author's absence. Thanks are also givin to W. H. Mecom and T. B. Randolph for assistance in conducting some of the field control experiments.

Figure 1. Three plants showing various stages of eggplant yellows disease. Plant on left has shown symptoms for about one week. Note lower branch still healthy. Center plant has had the disease for about three weeks. Plant on the right has had the disease for about two weeks. Note pattern of yellow color in leaves.

suspected that certain insects are carriers of the disease. Further success in controlling the disease was reported by Janes (4), Jones (5, 6), and Randolph (9).

In an effort to determine the distribution of eggplant yellows outside of Texas the picture used in figure 1, together with a description of the disease, was sent to horticulturists and plant pathologists in Alabama, Arizona, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, New Mexico, Oklahoma, Oregon, and South Carolina. What is said to be this disease was reported from Florida, Louisiana, Oklahoma, and South Carolina. A number of agricultural workers from northern states who have seen eggplant yellows in Texas reported that they had never seen it anywhere in the North.

SYMPTOMS OF EGGPLANT YELLOWS

The first symptom of the disease is the appearance of greenish-yellow spots in young leaves. These spots increase rapidly in size and frequently follow the veins until the entire leaf is yellow. The disease progresses down the branch until all leaves are affected (Fig. 1). Another branch will later exhibit the symptoms, always starting in the bud and

passing downward. The color of the diseased areas is first greenish-yellow, then orange-yellow, and finally almost white before the plant dies. It takes about 25 days for a plant to become completely yellow after the first symptoms appear, probably depending on the stage and rate of growth of the plant, temperature, moisture, and perhaps other factors. The disease first appeared in the experimental plots 2 to 4 weeks after the plants were set in the field during August. The period of most rapid spread usually occurred 6 to 10 weeks after transplanting. Plants infected early in the season usually die before fruiting, while those not taking the disease until later may bear some fruit. Since green tissue is necessary for growth and fruiting of eggplants, it is thought that the damage is in proportion to the amount of foliage affected and the stage of growth when infection occurs. Infected plants have never been observed to recover from the disease even though they may live through the winter and put out new foliage in the spring. The leaves do not become distorted nor is the general shape of the plant affected. The flowers appear normal in color and fruits are generally normal although occasionally they may be stunted, misshapen or streaked.

Several diseases affect eggplant in South Texas which might be mistaken for this disease by one who has never seen yellows. Confusion should not result if it is rememberd that in eggplant yellows the disease starts in the young leaves and passes down the branch and that the color is greenish-yellow at first, then orange-yellow and finally white.

The symptoms of eggplant yellows resemble those of potato calico as described and illustrated in color by Porter (8). However, these diseases are probably not the same.

EXPERIMENTAL PROCEDURE

These investigations were started in 1934 and continued through 1939. All field studies, unless otherwise stated, were conducted on sandy loam soil on Texas Substation No. 19, Winter Haven. The Florida High Bush variety was used in 1934 and Black Beauty in all later tests. Seeds were planted early in July in a bed and grown under part-shade until the plants were about two weeks old. The seedlings were watered by sprinkling at first and by flooding after emergence was complete. The average period from time of planting seeds to transplanting to the field was 40 days. The plants were set in the field about the middle of August in rows four feet apart and plants two feet apart in the row. The field was irrigated, fertilized and cultivated in the usual manner followed by commercial growers to produce good eggplant yields. The field plots usually contained about 200 plants. Treatments were not replicated, except in 1937. The plots were separated by four rows of tomatoes during 1938 and 1939 to guard against dust drifting from one plot to another.

The plants in the seedbed were dusted after each rain and sprinkling irrigation, and at least once each week to keep them lightly covered with

dust at all times. Dust was applied after transplanting early in the morning with a rotary hand duster at the rate of 20 to 25 pounds per acre per application.

The progressive increase of the disease throughout the season was determined by attaching a dated tag to each plant when the symptoms first appeared. In 1936 the yield of eggplants on an untreated check plot, having 93.0 percent of the plants diseased by the end of the season, was nearly one-third less than the yield on the dusted plot, and in most cases the quality was not as good. Other than this, yield records were not used to judge the value of the treatments.

RESULTS

Since it was suspected by the author that some insect vector might be scattering the disease, some preliminary tests were conducted in 1934 to determine the value of an insecticide for controlling the disease. About one-half of a small plot of Florida Highbush eggplants was dusted several times during September and October. None of the plants exhibited symptoms of eggplant yellows when dusting was begun. The dusted plot remained free of the disease and produced an excellent crop while the undusted plot had 71.1 percent of the plants diseased by the end of the season. Further experiments were designed to see if these remarkable results could be repeated and to learn how the dust prevented the disease.

Effect of Various Dusts

The following dusts were used in eggplant yellows control experiments 1934-39: (1) sulfur containing 2 to 3 percent conditioning agent and ground so that 93 to 95 percent would pass through a 325-mesh screen, (2) sulfur-cube containing 0.5 percent rotenone, (3) sulfur-pyrethrum containing 0.075 percent pyrethrins, (5) fuller's earth-cube containing 0.5 percent rotenone, and (6) hydrated lime. In these tests the plants were kept lightly covered with dust while they were in the seedbed and two or more applications were made beginning when the plants were set in the field (third section Table 1). Sulfur gave perfect control of the disease in four plots containing a total of 857 plants as compared with 42.0 percent diseased plants in the check plots. Only 1 out of 1275 plants in six plots dusted with sulfur-cube was diseased whereas in the corresponding untreated checks an average of 29.2 percent was diseased. Sulfur-pyrethrum dust gave perfect control in one test; however only 5.7 percent of the plants in the check became infected. This dust also gave perfect control of the disease in 1934 when it was not used in the seedbed but four applications were made, beginning at the time the plants were set in the field. Fuller's earth-cube was used on one plot containing 189 plants in which 11 or 5.8 percent became infected, in contrast to 44.0 percent infection in the untreated check. Hydrated

lime was used in the seedbed and 4 dust applications were made after transplanting in one test involving 196 plants, of which 10 or 5.1 percent became infected. The check plot containing 400 plants had 233 or 58.2 percent diseased. However, the hydrated lime caused stunting of the plants and should not be used for that reason. It has been observed that stunted plants are less susceptible to this disease than more vigorous ones.

Time of Application

Experiments to determine the most practical time to dust eggplants were conducted as follows: (1) dust applications were made throughout the time the plants were in the seedbed and no dust was applied after transplanting, (2) the seedbed was not dusted but two or more applications were made at 7 or 10-day intervals beginning at transplanting, and (3) dusting was done both in the seedbed and at 7, 10 and 14-day intervals after transplanting.

Dusting the plants while in the seedbed with no treatment after transplanting gave good practical control of the disease during 1937, 1938, and 1939. Only 24 or 3.7 percent of the 655 plants receiving this treatment were diseased as compared with an average of 37.2 percent infection in the untreated check plots. In no case was more than 4.8 percent of the dusted plants diseased (Table 1, section 1).

Plants which were not dusted while in the seedbed but were dusted two or more times beginning when they were transplanted to the field remained practically free of the disease. The corresponding untreated check plots had an average of 35.8 percent diseased plants. However, very poor control was obtained during 1935 when dusting was not started until two weeks after the plants were set in the field and 1.1 percent of the plants were already exhibiting symptoms of the disease (Table 1, section 2).

Dusting the plants in the seedbed and two or more times after transplanting with sulfur or mixtures containing sulfur gave almost perfect control in 11 plots. Only 1 of the 2348 plants used in this treatment became infected as compared with an average of 33.2 percent diseased plants in the checks. In this experiment the plants were kept lightly covered with dust from the time they came up until they were fruiting. Since the rainfall is normally light during August and September the dust which adheres well to hairy eggplants was seldom washed off the plants (Table 1, section 3).

Other Treatments

Tests were conducted to determine if the disease could be controlled by mixing dusting sulfur at the rate of 500 pounds per acre with the soil both in the seedbed and in the field. The sulfur was thoroughly mixed with the soil in the seedbed before the seeds were planted and

Table 1. The Effect of Various Treatments on the Control of Eggplant Yellows.

Year	Treatment in seedbed[1]	Treatment in field[2]	Number times dusted in field	Treated plots			Untreated checks		
				Number plants	Number diseased	Percent diseased	Number plants	Number diseased	Percent[3] diseased
1937	Sulfur-cube	None	0	225	5	2.2	450	42	9.3
1938	Sulfur-cube	None	0	230	11	4.8	607	267	44.0
1939	Sulfur	None	0	200	8	4.0	400	233	58.2
1937	None	Sulfur-cube	11	223	0	0.0	450	42	9.3
1938	None	Sulfur-cube	6	211	0	0.0	607	267	44.0
1936	None	Sulfur-cube	17	64	2	3.1	57	53	93.0
1934	None	Sulfur-pyrethrum	4	71	0	0.0	104	74	71.2
1935	None	Sulfur-pyrethrum[3]	4	461	198	43.0	483	266	55.1
1935	None	Sulfur[3]	4	497	220	44.3	483	266	55.1
1937	Sulfur-cube	Sulfur-cube	7	226	0	0.0	450	42	9.3
1937	Sulfur-cube	Sulfur-cube	9	221	0	0.0	450	42	9.3
1937	Sulfur-cube	Sulfur-cube	11	225	0	0.0	450	42	9.3
1938	Sulfur-cube	Sulfur-cube	2	199	1	0.5	607	267	44.0
1938	Sulfur-cube	Sulfur-cube	4	208	0	0.0	607	267	44.0
1938	Sulfur-cube	Sulfur-cube	6	196	0	0.0	607	267	44.0
1937	Sulfur	Sulfur	8	231	0	0.0	211	12	5.7
1938	Sulfur	Sulfur	6	225	0	0.0	607	267	44.0
1939	Sulfur	Sulfur	2	200	0	0.0	400	233	58.2
1939	Sulfur	Sulfur	4	201	0	0.0	400	233	58.2
1937	Sulfur-pyrethrum	Sulfur-pyrethrum	8	216	0	0.0	211	12	5.7
1938	Fuller's earth-cube	Fuller's earth-cube	6	189	11	5.8	607	267	44.0
1939	Hydrated lime	Hydrated lime	4	196	10	5.1	400	233	58.2
1938	Sulfur in soil[4]	Sulfur in soil[4]	0	221	16	7.2	607	267	44.0
1939	Sulfur in soil[4]	Sulfur in soil[4]	0	201	31	15.4	400	233	58.2
1936	Seedbed screened	None	0	64	31	48.4	57	53	93.0
1938	Seedbed screened	None	0	229	59	25.8	607	267	44.0
1936	Seedbed screened	Sulfur-cube	17	65	1	1.5	57	53	93.0
1938	Seedbed screened	Sulfur-cube	6	201	0	0.0	607	267	44.0

[1]The plants in the seedbed were kept covered with dust from the time they came up until they were transplanted to the field.
[2]Dust was applied in the field at approximately 20 pounds per acre, beginning at the time the plants were set in the field.
[3]The tests conducted during 1935 were begun after yellows was already appearing in the field.
[4]Dusting sulfur was mixed with the soil in the seedbed and field at the rate of 500 pounds per acre.

was placed in a furrow under the row before the plants were set in the field. No dust was ever applied on the plants. In two tests involving 422 plants, 47 or 11.1 percent took the disease as compared with an average of 49.6 percent infection in the check plots. The plants in the treated plots did not show bad effects from the soil application of sulfur (Table 1, section 4).

Since it was suspected that some insect vector spreads eggplant yellows, the following treatments were used during 1936 and 1938: (1) plants were grown under an 18-mesh screen wire cage while in the seedbed to protect them from insects and were grown in the open and not dusted after transplanting to the field, (2) the seedbed was screened as above but the plants were dusted 6 times in 1938 and 17 times in 1936, beginning when they were set in the field (Table 1, sections 5 and 6). Plants for check plots were grown in an open seedbed and were not dusted. Screening the seedbed and no treatment after transplanting resulted in 90 out of 293 or 30.7 percent infection as compared with 48.2 percent diseased plants in the checks. Screening the seedbed plus dusting after transplanting resulted in only one out of 266 plants becoming diseased. Plants grown under the screen cage were slightly spindling, but appeared normal shortly after transplanting to the field. Dusting the plants in the field beginning as soon as they are transplanted provides almost complete protection regardless of whether or not the seedbed is screened.

TRANSMISSION OF EGGPLANT YELLOWS

Since a high percentage of the plants in a field may have eggplant yellows, there must be some effective means of natural transmission. While insects are frequently supsected of transmitting many virus diseases, the species involved in some cases has not been determined. Peculiar habits of some insect vectors, such as feeding at night and leaving the plant during the day, migratory insects feeding for a brief period and then moving to another host, and other unusual habits make it difficult to determine the natural means of transmission.

Insects

Insects found in the eggplant seedbed and field were collected and identified. Many of those collected were feeding on a foamy sap, which exuded from wounds on the main stem near the bud. The cause of these injuries is not known but they were common about the time the first fruits began to set. Other insects appeared to be attracted to irrigated eggplant fields when the surrounding vegetation was dry. The following number of species was found in each insect order: Orthoptera 2, Neuroptera 2, Thysanoptera 1, Homoptera 14, Hemiptera 25, Coleoptera 24, Lepidoptera 3, Diptera 20, and Hymenoptera 15. Of the 106 species collected on eggplants, only a few are destructive and seldom are control

measures necessary. The following are pests at times in the Winter Garden: white flies, blister beetles, flea beetles and eggplant tortoise beetles. Collections were made in the field experimental plots by sweeping with an insect net to determine if there was any correlation between the abundance of any species and the amount of yellows in the plot. The common insects were uniformly present in all plots regardless of treatment and this did not lead to the suspicion of any species as being the vector. This sort of evidence was used to partially eliminate several of the most abundant species from the list of suspected vectors. Aphids have not been found on eggplants in the Winter Garden under field conditions. However, they are sometimes common on eggplants grown in a greenhouse during the spring months. This group contains more vectors of virus diseases than any other and was therefore carefully studied.

Transmission tests were conducted by collecting insects in an eggplant field and placing them on an infected eggplant for a few days and then transferring them to a caged healthy plant where they were left for a week or longer. The following species were tested in that manner: *Gratiana pallidula* (Boh.), *Psallus seriatus* Reuter, *Euryopthalmus succinctus* (Linn.), *Thyanta custator* (Fabr.), *Empoasca fabae* Harris, *Gargaphia solani* Heidemann, *Trialeurodes abutilonea* (Hald.), and *Thrips tabaci* Lindeman. None of these insects transmitted the disease from infected to healthy plants. Several tests were conducted in which mass collections were taken from a field where a high percentage of plants was infected and placed on caged healthy plants. In one test a plant took the disease, but the symptoms did not appear until more than two months after the insects were placed in the cage. Two other plants in this cage remained healthy. So far no insect species has been proved to be the vector of eggplant yellows.

Artificial Inoculation

Studies on artificial inoculation have been conducted by Dr. S. S. Ivanoff (2), Plant Pathologist, Texas Agricultural Experiment Station, Substation No. 19, who reports the following:

"This disease, locally known as 'eggplant yellows' and resembling in symptoms the calico type of virus disease was transmitted to healthy plants of the variety Black Beauty by inoculation with extracted plant juice, both by rubbing and by puncturing. There were more than 10 inoculation trials made in the seedbed and in the field during various seasons in which approximately 1000 plants were employed. Infection resulting from inoculation varied from 0 to 12 percent, with the control of uninoculated plants remaining healthy after the usual incubation period. The degree of infection apparently depended upon the condition of the plants, upon the dilution of the infectious juice and perhaps upon other factors not well understood. Ordinarily the disease was not transmitted or transmission was very low when the inoculated plants were stunted or were growing abnormally because of unfavorable en-

vironmental conditions. The highest infection by artificial inoculation was produced when the plants were young and growing vigorously. Natural infection is much more common during the fall growing season than during the early spring season.

"The incubation period varied from 14 to 24 days, apparently depending upon season and temperature. In spring most of the infected plants had an incubation period of 18 to 21 days.

"Infection was produced regardless of whether the inoculated plants were treated previously with sulphur or not. In one case young plants were dusted 4 times previous to inoculation and 2 or more times after inoculation. Eleven percent of the inoculated plants became infected while the plants which were likewise dusted but not inoculated, remained healthy. Infection was also induced in plants in which, previous to inoculation, a few drops of a 2 percent suspension of colloidal sulphur were injected. It seems that the presence of sulphur within the plant or as dust upon the plant does not significantly prevent artificial infection.

"Extracted plant juice from diseased plants, slightly diluted with water, was passed through a Seitz filter and then used to inoculate healthy plants but, in the few trials made, no positive case of infection occurred. Seed obtained from diseased plants produced only healthy plants.

"Attempts to isolate a causal microorganism on common culture media, from diseased leaf, petiole, and stem tissue, under aseptic conditions, have so far been unsuccessful. It appears that this disease is an infectious one and caused by a virus." Following recent inoculation (3) it appears that the disease is closely related to cucumber mosaic.

Grafts

Transmission studies were conducted during 1938 in which buds from a plant showing symptoms of eggplant yellows were grafted onto apparently healthy plants. The grafts were made on plants which had previously been dusted with a sulfur-cube mixture while in the seedbed and four times at 10-day intervals after they were set in the field. The grafted buds lived on 12 plants and the disease was transmitted in every case. The symptoms appeared after an average period of 31 days. The remaining 207 plants in the plot which were also dusted but not grafted did not take the disease. In a number of instances where the grafted buds failed to live, the plants remained healthy even though the diseased buds were in contact with the cut surface of the healthy plants for a week or longer. These results confirm those of Taubenhaus and prove the infectious nature of the disease. The continuous presence of a sulfur-cube dust on plants prior to the time the graftings were made did not prevent transmission of the disease.

Tomato buds were grafted on infected eggplants and infected eggplant buds on tomatoes. Although the grafted buds lived, the tomato plants did not develop symptoms of eggplant yellows. Eggplant is the only plant known at present which exhibits symptoms of this disease.

DISCUSSION

It is not understood how the various treatments used in these experiments acted in controlling eggplant yellows. While sulfur or mixtures containing sulfur both as a dust and soil amendment were specific in controlling the disease, dust applications of fuller's earth-cube and hydrated lime were also effective. It seems doubtful that the disease control obtained by all of these treatments can be satisfactorily explained with the information at hand on the basis of insect vector control alone. If some insect is involved it must be easily killed or repelled by all of these materials. It is thought that the hydrated lime dust controlled the disease by stunting the plants, as already pointed out, since it is not known to be of much insecticidal value. The author has no explanation to offer as to how the soil treatment with sulfur acted in controlling the disease, and suggests that further work is needed along this line. While screening the seedbed to protect the plants from insects gave some control of the disease, this method was not as effective as dusting the seedbed only; it should be pointed out that the screened plants grew somewhat spindling due to the part-shade and it is thought that this abnormal growth might have influenced the greater amount of infection taking place. Although an insect vector of eggplant yellows has not been found, this possibility has by no means been exhausted.

The time infection takes place has not been definitely determined but according to the second and last sections of Table 1 it takes place with few exceptions in the field after transplanting. However, very little control was obtained when treatments were started after infection has already occurred, as in 1935 when dusting was begun two weeks after the plants were set in the field. Since the disease increased most rapidly during October, or 6 to 10 weeks after the plants are set in the field, it appears that infection, based on the length of the incubation period following artificial inoculation, must largely take place after transplanting. If that is true, the dust which was applied in the seedbed thereby providing very economical protection probably adhered to or affected the plants for a considerable period of time and prevented infection taking place later.

It is not understood why eggplants grown in the spring or early summer months are largely free of the disease while those grown later in the year in the same area are so badly affected. Diseased plants which live through the winter continue to exhibit typical symptoms in the spring, for the disease is readily transmitted through grafting during the spring months.

CONTROL RECOMMENDATIONS

The cheapest and most practical control of eggplant yellows was obtained by dusting the plants in the seedbed with sulfur. The dust may be applied with a small hand duster or shaken from a cloth sack. About

ten pounds of dusting sulfur should be enough to use on a seedbed of sufficient size to plant one acre of eggplants. The plants should be kept covered with the dust from the time they come up until they are transplanted to the field. As an additional precaution, the plants should be dusted at the time they are pulled for transplanting to the field. The sack or dust gun used should be kept in a convenient place so that the seedbed can be dusted after every rain and at least once every week to keep the growth covered with sulfur. The additional control ob-

Figure 2. Two plots of eggplants on November 16, 1939, which were separated by four rows of tomatoes. Top picture of untreated check had 58.2 per cent of the plants diseased. The bottom picture shows plot which had plants dusted with sulfur while in seedbed and not dusted after the plants were set in the field. Only 3.5 per cent of these plants were diseased.

tained by making dust applications after the plants are set in the field has not been found profitable.

The important point to remember is that dusting should be done before the disease appears since no method is known which will restore health to the infected plants.

SUMMARY

Eggplant yellows occurs during the late summer and fall months in South and Central Texas, and what is said to be the same disease was reported in Oklahoma, Louisiana, Florida, and South Carolina. It is infectious and appears to be caused by a virus. Conspicuous yellow spots which first appear in the young leaves increase rapidly in size, frequently following the veins, until all the green chlorophyll is destroyed, in about 25 days. The disease first appears when the plants are 8 to 10 weeks old and increases rapidly after that time. The contrast of yellow and green in an eggplant field is apparent at considerable distance, especially about harvest time when most of the plants may be diseased. The reduction in yield depends upon the percentage of plants diseased and their age when infection occurs.

The method of normal transmission is unknown. It does not appear to be readily transmitted under natural conditions during cultivation, irrigation or harvesting. Infection resulted after 31 days when diseased buds were grafted on healthy plants. While insects are suspected of transmitting the disease, definite proof is lacking.

Control studies involving 9,092 plants on 54 field plots were conducted at Texas Substation No. 19, Winter Haven, during the period 1934-39. The plants were grown under natural conditions, following the practices used by progressive eggplant growers.

It was found that sulfur, sulfur-pyrethrum, sulfur-cube, fuller's earth-cube and hydrated lime dusts were all effective in controlling the disease when applied before infection took place, but the most economical results were obtained by the use of straight dusting sulfur.

Practical control was obtained when the plants were kept lightly covered with dusts containing sulfur throughout the time they were in the seedbed and no treatment after transplanting. Slightly better control of the disease was obtained by making four or more dust applications at 7 or 10-day intervals, beginning at the time of transplanting to the field. Practically perfect results were obtained when the plants were dusted both in the seedbed and after transplanting to the field. The results were unsatisfactory when dusting was begun after infection had already taken place and a few of the plants were exhibiting symptoms of the disease. No method has been found for restoring health to diseased plants.

Soil applications of sulfur at the rate of 500 pounds per acre, both in the seedbed and in the field, resulted in 10.0 percent infection as com-

pared with 49.6 percent in the checks. Indications are, however, that the disease is not due to a soil deficiency of sulfur. Plants in the seedbed grown under a screen wire cage for protection against insects had about one-half as much infection as the checks.

The most economical control found consists of keeping the seedbed covered lightly with sulfur dust. This treatment is inexpensive and easy to apply.

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